AMERICAN ANNALS OF THE DEAF

FOUNDED 1847

Official Organ

Conference of Executives of American Schools for the Deaf

FOUNDED 1868

Convention of American Instructors of the Deaf

FOUNDED 1850

POWRIE V. DOCTOR
Editor

LEONARD M. ELSTAD
Associate Editor

Under the Direction of the Executive Committee of the Conference

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AMERICAN ANNALS OF THE DEAF

Vol. 99 March, 1954 No. 2

Measuring the Intelligence of Deaf Children

A New Group Test

J. M. Du Toit, Ph. D.
School for the Coloured Deaf, Worcester, South Africa

WHILE there exist today several systems of individual performance tests of intelligence suitable for the deaf, which, though perhaps not of proven value, seem to be promising and potentially useful, no satisfactory and comprehensive group test of the more abstract paper and pencil type has so far appeared for them.

The one which has been used most generally, is probably Pintner's Non-language Group Test. In actual use we found this test very unsatisfactory in many respects, more especially when an attempt was made to assess the general intellectual capacities of the deaf as compared with those of normal children. It was not surprising to find the Non-language Test yielding consistently lower results for the deaf than any of the other types of tests. (Compare Mackane's results (3) and Helen Lane's summary (4).) The crying need for a new group test has for a long time been evident.

In our own attempt several basic principles were decided on *a priori* in view of the nature of the problem and in the light of our own experience in a school for the deaf. Other of these conditions arose in the course of preliminary tryouts of many different types of tests that were being considered. The most important of these conditions can be briefly stated as follows:

(I) The tests should presuppose as little as possible and should not in any way be dependent on schooling,

acquired information such as is taught in school, degree of language acquisition or special environment.

For reasons set out before, this requirement is much more essential and strict in the case of tests intended for use with the deaf than in the case of ordinary tests.

No written word or letter or numeral should be included in the tests or instructions, or required in the responses.

Representations of objects should be limited to the elemental and universal, such as parts of the human body and its actions; the recognition of the difference between plants and animals, flowers and leaves, can also be reasonably expected, as also some acquaintance with the most elementary and universal implements of mankind such as the axe, the hammer, chair and table. But very few such items were included in the whole gamut of some 160 items constituting our battery.

It goes without saying that in order to be able to take the test a child must have the muscle-coördinating ability necessary to enable him to hold a pencil and to manipulate it for the purpose of producing the simple markings required. A certain amount of previous experience with paper and pencil is therefore necessary.

As in the case of all group tests, the child should also, to some extent at least, be accustomed to classroom discipline and should be at a stage where he is able to keep his attention on the task for some time. For this reason a fairly long group test can only in exceptional cases succeed with children of say, six years of age.

(II) It must be possible to give the necessary instructions, without any possibility of ambiguity or vagueness, by means of pantomime or gesture only. Moreover, it must be possible to confine such instructions in their essence to a minimum. Any test requiring complicated explanations is useless. This does not mean that much time may not be required for the instruction stage, as numerous repetitions and examples are often necessary. But the essential nature of the instructions must not be involved and it must be possible to deduce what is required without any difficulty, mainly from examples. It is interesting to compare the blank expression persisting on many faces in the case of some types of tests with the dawning of the quick light of understanding found in case of the successful type.

Many otherwise excellent tests have to be discarded because they cannot be made to comply with this condition.

(III) No speed tests should be included and all restrictive time limits discarded. It is tremendously difficult to make a deaf child realize, all at the same time, that he should work as fast as possible, but yet with care and accuracy; that he should start immediately at a given signal and stop at another; that he should not waste any time on erasures or overcareful drawing and attempts at superlative neatness; that if he cannot solve one item, he should immediately proceed to the next and return to the one skipped later on if there is time; that if the point of his pencil should break, he should hold up his hand for another. And yet, if all this is not perfectly well understood at the outset, a time limit becomes basically unfair, especially in what is essentially a speed test.

(IV) Abundant practice material has to be provided in order to get the subject acquainted with the exact nature of the task that is required of him. This practice material really forms part of the instructions for each test and has the further important function of enabling the examiner to ascertain to his complete satisfaction whether every subject has fully grasped the directions and to clear up remaining individual uncertainties.

This constitutes one of the essential features of our new test. It also necessitates that a good deal of time and patience be spent on this stage when administering the test.

A poor score should be the result not of failure to understand the general nature of the task set, but merely the result of inability to solve the problem in the case of individual items. Failure to realize the importance of this condition was one of the rocks on which previous attempts at the construction of group tests for the deaf foundered.

(V) Every subtest has to contain a good many items in order to provide sufficient opportunity for the child, and so that accidental success or failure on a single item will not unduly influence the final result.

As has often been pointed out before, fewness of items was one of the weaknesses of Pintner's test.

(VI) The test material should be of such a nature and so arranged as to capture and retain the interest of deaf subjects. Where time limits are not imposed, it is not necessary to arrange components of tests in strict order of increasing difficulty. The order may

be somewhat varied in order to re-establish confidence and to retain interest.

(VII) We considered it unwise to strive after speed of administration. It was realized that in order to form a reasonably reliable estimate of the general intellectual ability of a deaf child we should have to be willing to spend ample time and effort and patience in the attempt. Ease and speed of administration, while not to be entirely disregarded, could not therefore be accepted as among the primary conditions for our purpose.

It is not possible to describe the process of construction of our test here in detail. We can only give a brief indication of some of the final stages.

After eliminating a number of tests which had been under consideration in the preliminary stages, we were left with ten types of tests showing some promise. These were:

1. Pintner's Four Dots.
2. Completion of Symbol Series. This was something of the nature of subtest 3 of the American Army Beta, and similar in principle to No. 3 of the Kingsbury Primary Test (7), some of the items of which were incorporated.
3. Classification. In a series of five or six representations of objects of abstract figures which could be classified as belonging together with respect to some single attribute they have in common, one was included that did not fit into this category, and had to be detected.
4. A Matrix Test based on Raven's progressive matrices. (8)
5. The Goodenough Draw-a-Man Test. (9)
6. Figure Recall. A series of geometrical figures of increasing complexity, each exhibited for a short period, had to be reproduced from immediate memory.
7. A Maze Test.
8. Identical Pairs. In each row of five similar figures the only two identical ones had to be detected. This test was based on Thurstone's Faces-test (10) from which some of the items were derived.
9. Symbol Sequences in Pairs. Some pairs were identical, others different. The identical pairs had to be indicated.
10. Sequence of Three Symbols. In a lengthy series of small figures every occurrence of a certain group of three in a definite order had to be encircled.

These tests, together with a very well standardized criterion test, were applied to five percent of all ten to twelve year old pupils in eight schools for normal children, selected by means of Fisher's tables of random numbers. (11)

Analysis of variance of the results proved that we were justified in considering the eight sub-groups, as far as these tests are concerned, as random samples from the same population and therefore adequately representative of the total population of ten to twelve year old school children of the area concerned.

Intercorrelations of all these tests were calculated and by means of factor analysis of the results, the saturation of each test with a first, presumably general, factor determined. These saturation coefficients are presented in Table I.

TABLE I

GENERAL FACTOR SATURATION COEFFICIENTS

TEST NO.	COEFFICIENT	TEST NO.	COEFFICIENT
Criterion	.782		
1	.565	6	.741
2	.779	7	.598
3	.655	8	.756
4	.830	9	.558
5	.472	10	.612

Upon removal of the first factor influence the residual correlations were found to be completely insignificant except for the residual of $r_{8,9}$ which barely reached significance at the 5 per cent level, and that of $r_{5,6}$ which reached the one per cent level. There appeared to be no indication of further or group factors influencing our tests appreciably. It was therefore not necessary to discard tests on account of high intercorrelations as these had proved to be a consequence of high saturations with one general factor.

The correlations of the tests with the South African Group Test of Intelligence (12), a test very well standardized on some 17,000 school children, and used by us as criterion, are given in Table II.

TABLE II

COEFFICIENTS OF CORRELATION WITH CRITERION TEST

TEST NO.	COEFFICIENT OF CORRELATION	
1	.495	
2	.662	
3	.525	
4	.675	Values of coefficient required for significance at the 5% and 1% levels = .139 and .182 respectively.
5	.432	
6	.557	
7	.417	
8	.549	
9	.377	
10	.444	

The following six tests were then chosen for inclusion in the final battery:

No. 4 Matrices
No. 2 Completion of Symbol Series
No. 8 Identical Pairs
No. 6 Figure Recall
No. 3 Classification
No. 1 Pintner's Four Dots.

Correlations with the criterion and saturation coefficients were clearly not the only considerations in making the final selection. So, e.g., No. 1 was found in use with deaf pupils to form an excellent test with which to establish rapport between examiner and subjects and to obtain the necessary attitude and atmosphere. In this test the children are not left to themselves to carry on on their own initiative. There is continuous interaction between examiner and subjects. The presentation can be brief, the instructions are easily understood, the reaction required for every item is brief. By nature of the test pupils are brought to the alert and to a state of concentrated attention. Most pupils enjoy the test as a kind of game. By the time it is completed, confidence has usually been established, interest awakened, the unfamiliarity of the situation and the examiner have decreased and the pupils are in a better condition to tackle the next test where they have to work on their own. For such reasons Test No. 1 was included and placed first in order of presentation. It was included practically unaltered, as a tribute to Pintner who, notwithstanding our criticism of his Non-language Test, deserves our gratitude for his interest in the

psychological problems of deafness and the great amount of work he has done and instigated in this connection.

Judging by the general reaction of deaf pupils all the other tests also seemed to have high interest value and were almost always quite evidently enjoyed. In final selection, in arranging the sequence of tests and the sequence of items, this need for retaining sustained interest as far as possible was always kept in mind.

The tests retained were then subjected to further detailed item study, which need not be recounted here. On the basis of data so obtained it was possible to eliminate some items and effect some re-arrangement of others.

Reliability: Two methods were used to determine the reliability of our finally constituted test.

First, alternate items of every subtest were allocated to two forms of the test, designated A and B. Hence two partial scores were determined for each of 200 hearing subjects by totalling the score for each on forms A and B separately. The Spearman-Brown formula yielded a coefficient of reliability given by

$$r_{AB} = .959.$$

Secondly, the reliability was tested on deaf pupils. The full test was given to a group of 60 deaf children who were then re-tested some three months later. The coefficient of reliability so obtained was found to be

$$r_{I,II} = .969 \pm .003.$$

Validity: Different criteria were used for measuring the validity of the test.

The South African Group Test, mentioned before, was the first. This, being a typical verbal test, could of course only be applied in the case of hearing children. As our hearing subjects were drawn from different schools, the correlation between our test and the criterion was calculated by means of the method of analysis of covariance. The result could be corrected for attenuation in the usual way, reliability of both tests concerned being known. It would, however, be preferable to correct only for the degree of reliability of the criterion, so that we obtain the correlation coefficient between our test as it stands (not

infinitely lengthened) and an infinitely reliable or infallible criterion. In this way we obtained as measure of validity.

$$r_{x,y} = .802.$$

By use of Fisher's *Z*-function we found the reliability of this coefficient, at the one per cent level, to be given by

$$r = .802, + .056$$
$$or - .076.$$

For a second test of validity use was made of teachers' judgment of the intelligence of deaf pupils. Each class teacher was asked to classify his pupils in five categories, viz., very bright, bright, average, dull, very weak. These pupils were also classified in five similar categories on the basis of the test results, and the coefficient of contingency for these two systems of classification determined by means of Pearson's formula. This was done for every school for the deaf separately, as the standards of classification differed so widely between schools that it was out of the question to pool results. The results are given in Table III.

TABLE III

COEFFICIENTS OF MEAN SQUARE CONTINGENCY BETWEEN TEST RESULTS AND TEACHERS' JUDGMENT, (DEAF PUPILS)

School	Number of Pupils Tested	Number of Classes (and Therefore of Judges)	Coefficient of Contingency
St. Vincent School, Johannesburg	87	10	.603
Skool vir Dowes, Worcester, C. P.	192	22	.490
School for the Coloured Deaf, Worcester, C. P.	90	8	.636
Dominican School, Wittebome, Cape Town	174	18	.514
Kutlwanong School, Roodepoort, Transvaal	28	3	.690

It should be noted that the maximum value that the coefficient of contingency can attain in a five-by-five table is .894. Terman found the correlation between I.Q.'s on the Stanford Binet-Simon and teachers' rankings

on a five-point scale to be .48, which he considered highly satisfactory (13). Taking into account the special circumstances existing in schools for the deaf, the contingencies found can be regarded as strong confirmation of the validity of our test.

As a third test of validity the results of the group test were compared with results from an individual test specially constructed for the deaf, the very interesting Snyders-Oomen Test from Holland—unfortunately not as well known as it deserves (14). This comparison yielded a coefficient of correlation, in the case of a group of 60 deaf pupils, given by

$$r = .746 \pm .050.$$

(The correlation between the South African official Individual Scale and the South African Group Test is very similar, viz.:

$$r = .73?8 \pm .0365 \text{ (15).})$$

We also wished to determine to what extent that which we were measuring was the product of education and training instead of the native capacity we were trying to probe. This problem is of especial significance in case of the deaf, with whom the degree of command of verbal language is largely bound up with the duration of school attendance.

Those who have only just come have no notion of verbal language and therefore do not possess the language symbols which are often regarded as indispensable for the development of abstract thought. If mental development is retarded by lack of verbal language, we would expect a decrease in this retardation as the child gains command of language and practice in its use. This would mean a tendency to improvement in the I.Q.'s with increase in the duration of the educational process. Coefficients of correlation between I.Q.'s and the period the child has been attending school were determined with a view to throwing some light on this problem, and are presented in Table IV.

TABLE IV

CORRELATION BETWEEN I.Q.'S AND DURATION OF SCHOOL ATENDANCE*

School	Number of Cases	Coefficient of Correlation	VALUE OF r REQUIRED FOR SIGNIFICANCE	
			at the 5 per cent level	at the 1 per cent level
St. Vincent School, Johannesburg	80	−.026	.220	.287
Skool vir Dowes, Worcester	180	.0603	.148	193

*Only those who have been at school not less than one year but not more than twelve years have been included.

The correlations are quite evidently completely insignificant. We conclude that that which our test measures is not to any appreciable extent influenced by schooling or by language mastery.

The problem of the influence of language was also studied from a different angle.

We classified pupils into two categories: those who acquired any language they possess entirely through artificial teaching and those who acquired their language by natural means. The first class included all those born completely deaf for all practical purposes, those who lost their hearing and so their language very early, usually before their sixth year, and those with some residual hearing which, however, they do not utilize for some reason or other, probably poor intelligence. The second class included those hard of hearing pupils whose residual hearing enabled them to acquire at least some language, even if restricted, in a normal way. Amongst these might be found children with a greater loss of hearing than some included in the first category, but utilizing their little hearing to a greater extent, possibly, one would surmise, as a result of a more alert intelligence. (The presence of this type here would seem to favour a somewhat higher average I.Q. for this category.) We also had, in this second class, all pupils in hard of hearing classes, receiving normal instruction through hearing aids, and also those who, though completely deaf, became so after having acquired their language normally, and retained it notwithstanding

possible deterioration in speech and the absence of further development.

The difference between these two categories of the deaf is profound and is the result of all that language as a natural instrument of thought, communication and expression implies.

Biserial r between I.Q.'s and these two categories of pupils was calculated for 100 pupils in the only school available containing a fair number of pupils in the second category. Of the group of 100 there were 38 possessing naturally acquired language, while the remaining 62 had acquired their language entirely by artificial means. We found

$$r_{bis} = .1601$$

in favour of the group with artificial language. For significance at the 5 per cent and 1 per cent levels the values of r would have had to be at least .197 and .256 respectively. If any actual relationship did exist, one would have expected it to be in favour of the group with natural language. The result obtained, while superficially seeming to point in the opposite direction, merely serves to indicate the absence of any relationship.

Again we seem justified in concluding that our test appears to be entirely independent of language ability in so far as such ability is dependent on the sense of hearing.

Norms: The method of derivation of norms cannot be described here. It should be stated, however, that on account of lack of sufficient subjects in the different age groups in South African schools for the deaf, norms could not be determined empirically. The norms, as now available, were derived in a somewhat unorthodox way, and are based on the norms of the criterion test, which itself is, at the time of writing, *sub judice*. Our norms are therefore considered as provisional and even tentative only. Nevertheless, we found the distribution of I.Q.'s based on these norms in the case of 180 pupils of one school to conform very satisfactorily to a normal distribution, as appears from Table V.

TABLE V

DISTRIBUTION OF SCORES OF 180 DEAF PUPILS IN ONE SCHOOL

I.Q.	No. of Cases	Percentage
Below 70	3	1.67
70–79	9	5.00
80–89	20	11.11
90–99	57	31.67
100–109	57	31.67
110–119	22	12.22
120–129	10	5.55
130 and over	2	1.11
TOTAL:	180	100.00

In this case the mean was 99.96, the standard deviation 12.98, and the value of $\chi^2 = 6.954$. The value of P corresponding to this χ^2 and 8 frequency groups is found in Pearson's tables to be .436, which, being more than .2, indicates a good fit. (Pupils in special classes for the mentally retarded were excluded.)

When considering the mean I.Q. of 99.96 in this case, and of 98.53, for a group of 289, from different schools, it should be borne in mind that our norms, such as they are, have been derived from the results of hearing subjects.

Summary—Hitherto existing group tests of intelligence for the deaf were considered inadequate and unfair. The poor showing of deaf children on such tests, from which conclusions of mental retardation due to deafness were sometimes drawn, could possibly also be ascribed to shortcomings of the tests, a result, we presumed, of lack of intimate acquaintance and experience with the deaf and their peculiar difficulties on the part of the authors and examiners concerned. Some of the important principles to be taken into account when constructing tests for the deaf, were stated, and a brief outline given of the methods followed in our own attempt. The coefficient of reliability of this new test was found to be high (.959 by the split half method, with hearing subjects; .969, by repetition, with deaf subjects). The validity was tested by three

different criteria: standard group test (in the case of hearing subjects), teachers' ratings, and an individual test specially constructed for the deaf. As a result, our test was deemed highly valid. Some calculations, performed to prove the complete exclusion of any influence of language on our test, were described; the findings in this connection could also be considered to throw some light on the general problem of the influence of language on intelligence. Our norms were specifically stated to be provisional and the need of better, empirical norms, pointed out. Nevertheless our present norms were found to yield a distribution to which the normal curve provides a very good fit. The mean I.Q. found for 289 deaf children, different schools combined, was 98.53 and for 180 deaf children in one school 99.96.

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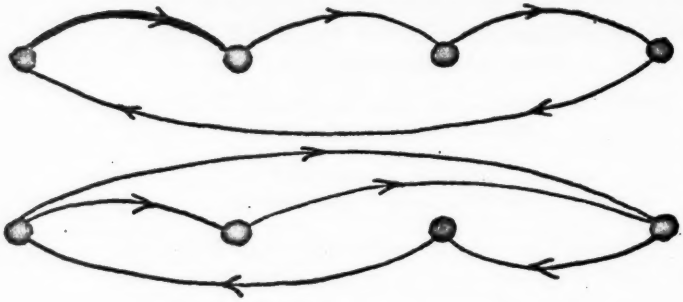
APPENDIX

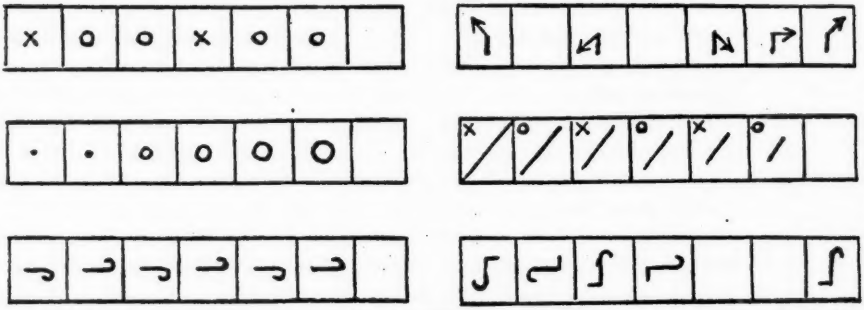
Sample Items from Each Subtest

Subtest A: Pintner's Four Dots (Referred to in text as No. 1)



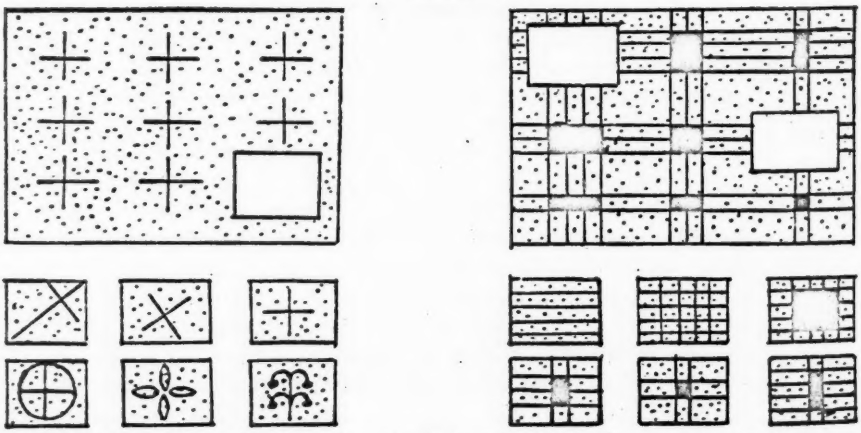
The examiner traces, with a blackboard pointer, an imaginary line connecting the four dots in a certain order. The person taking the test has to connect the four dots of the same item on his booklet in the same order, by means of a pencil line.

Subtest B: Series Completion (No. 2)



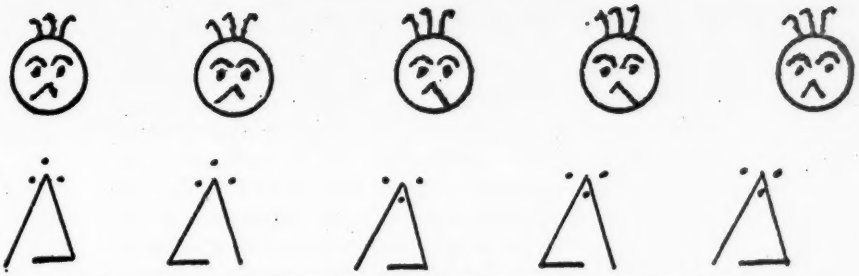
In each sequence of symbols some principle of progression, alternation, or other systematic relationship, has to be discovered and the blank cells filled up in such a way as to conform to this principle.

Subtest C: Matrices (No. 4)



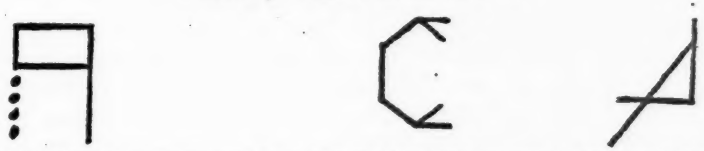
Out of the six rectangles underneath each matrix, the testee has to select the one (or two, as the case may be) that would fit into the blank space (or spaces) in the matrix, conforming to and completing the pattern.

Subtest D: Identical Pairs (No. 8)



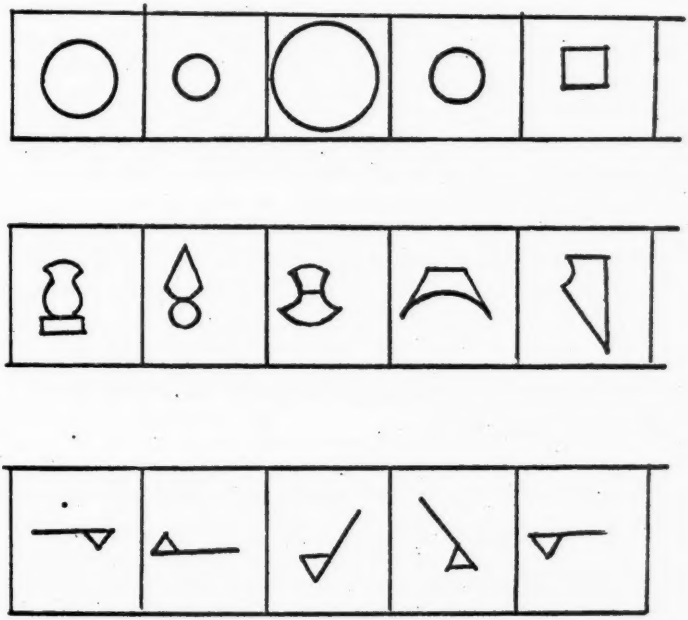
In each row of five similar figures the only two identical ones have to be detected and marked.

Subtest E: Figure Recall (No. 6)



Geometrical designs of increasing complexity, each exhibited for a prescribed short period, have to be reproduced from immediate memory.

Subtest F: Classification (No. 3)



Except for one misfit, all the figures or representations of objects in each row can be classified as belonging together with respect to some single attribute they have in common. This unifying principle in each row has to be discovered and the one figure or object not conforming to it, detected and marked.

A Qualitative Analysis of Explanations of Physical Causality

I. Comparison of Hearing and Defective Hearing Subjects

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THERE is a relationship between the adequacy of the causal explanations of physical phenomena which individuals offer and their intellectual ability, experience, and specific training. It has been found that inferior explanations evaluated on a quantitative scale of scientific accuracy are offered by defective hearing children more frequently than by hearing children of the same age, grade, and intelligence. The difference between the adequacy of the explanations made by the hearing and the defective hearing subjects increases as the defective hearing become older or as their hearing loss becomes more severe (5).

Causal explanations also can be classified qualitatively according to the causative source appealed to in the explanation. For example, the explanation of why an airplane stays up in the air may be made by an appeal to the supernatural, "Because God made it stay there"; by an appeal to some incidental aspect of the total situation, "Because the pilot is a marine"; by an appeal to a single mechanical aspect of the situation, "Because it has a propeller"; by a logical statement of the scientific principles involved; etc. There is some relationship between a quantitative score assigned to an explanation according to its scientific accuracy and a qualitative classification assigned on the basis of the source appealed to in the explanation of causality. However, explanations may appeal to a variety of sources as causative factors and receive the same or similar quantitative scores. This is particularly true of the more inadequate explanations which receive a low quantitative score and may invoke any one of a variety of causative sources.

In the present study qualitative evaluations of the explanation of physical causality are based on two classifi-

cations: (1) Piaget's classification into types of causality found in child thought, and (2) Deutsche's classification into the type of agents, either materialistic or nonmaterialistic, involved in the explanation. Piaget, a Swiss psychologist who has done extensive pioneer work in the area of child thought, has set forth several stages of causal thought progressing from prelogical to logical reasoning (3). Deutsche studied the development of causal thinking in American children from kindergarten age through sixteen years (2). Analyzing the explanations of a variety of physical phenomena made by 732 subjects, she reported a relation between the explanation of a specific phenomenon and both the quantitative score and the qualitative classification it received. Although there was an increase in accuracy and a shift in characteristic type of explanation with age, she found gradual transitions rather than definite stages over the age range covered. Since the present investigation follows the method used in the Deutsche study, comparisons between the findings are made whenever possible.

The Questions

The questions used in the present study deal with the causes of a variety of physical phenomena. They were devised by Deutsche but are based primarily upon the earlier work of Piaget. Answers to the following 21 questions were written by both hearing and defective hearing subjects as part of a larger study of reasoning. Nine of the questions were demonstrated by the experimenter when presented to the subjects; twelve of the questions were not demonstrated.

Demonstrated questions

1. Why does the candle go out?
2. Why doesn't the penny fall out?
3. Why does the water come up higher when I put the pebble in?
4. What makes the water change color when I put in some colorless stuff?
5. What makes the water go up in the tube when I let go of the bulb?
6. Why do I have to put a big block at one end to make the teeter-totter balance?
7. Why does the colored liquid separate from the colorless liquid?

8. Why don't the paper and the water fall out of the jar?
9. Why does the water run uphill in the little tube?

Undemonstrated questions

10. What makes the wind blow?
11. What makes the snow?
12. Why do balloons go up in the air?
13. Two men, both named Carl Jenkins, were killed at four o'clock the same day, one in San Francisco, one in Kansas City, and both were killed in an automobile accident. How do you explain this?
14. What makes the rainbow after the rain?
15. What makes airplanes able to stay up in the air?
16. What makes frost on the windows in wintertime?
17. Why do boats float on top of the water instead of sinking?
18. A man built a barn, and it was hit by lightning. He built it again three times and each time lightning struck it and it burned. How do you explain why it was struck by lightning four times?
19. What makes shadows?
20. What causes thunder?
21. How is it you can see yourself when you look into a mirror?

Qualitative Classification of Explanations

All of the explanations written were classified qualitatively according to Piaget's, and Deutsche's classifications.

Piaget classification. Piaget classified causal thought into 17 categories based upon his observation of trends from prelogical to logical thinking in the child. Deutsche has summarized these categories and added an eighteenth, "Trickery" (2: 51, 52).

Motivational causality—A psychological motive is the cause of things. God or men send us dreams because we have done things which we ought not to have done. Things are conscious, or specially made by man.

Finalism—Simple finality without origins or consequences of finalism being noticed. River flows so as to go into the lake. Not necessary for river to be conscious or have a motive.

Phenomenistic causality—Two facts given together in perception, and such that no relation subsists between them except that of contiguity in time and space. Pebble sinks to bottom of water because it is white. No concept of relations.

Participation—Two things with some resemblance or affinity can act upon each other at a distance. One a source of emanations, the other an emanation from the first. Shadows in room emanate from shadows out-of-doors.

Magical causality—Gestures, thoughts, etc., charged with efficacy. Certain word acts on certain thing. White pebble makes water lilies grow.

Moral causality—Moral necessity. Boats have to float, otherwise they would be of no use.

Artificialistic causality—Event explained by intention or motive at back of it, but child doesn't ask himself how this intention worked itself out of action. Event or object to be explained is conceived as the object of human creative activity.

Animistic causality—An internal biological tendency that is both alive and conscious. Clouds move because they are alive.

Dynamic causality—Animism gone, but still sees in objects forces that are capable of explaining their activity and movements.

Reaction of surrounding medium—No animism. Continuity and contact. Clouds driven along by the air which they produce in their flight.

Mechanical causality—Explanation by contact and transference of movement. No internal force at all. Wind pushes the clouds. Pedals make bicycle go.

Causality by generation—Things are born out of each other. Clouds come out of smoke, air, fire. Sun comes out of fiery cloud.

Substantial identification—Bodies are born from each other, but are not endowed with power of growth. Sun is a collection of clouds rolled up into a ball.

Schemas of condensation and rarefaction—Used to explain qualitative differences in substances. Hardness of stone comes from the fact that earth is close; water light because it is thin, liquid; wood heavy because big, thick, full, etc.

Atomistic composition—Substances made up of particles tightly or loosely packed together. Stone is made of little stones, which are made of grains of earth.

Spatial explanation—Explains rise of water level when pebble is put into water by volume of immersed body. Explains shadows by perspective.

Explanation by logical deduction—Explanation by the principle of sufficient reason. Water flows into the second of the connected tubes because water can go

equally well in both directions. Uses concepts of density, specific weight, etc.

Trickery—Implication that there is some trick in the experiment.

Deutsche Classification. Deutsche classified the causal explanations according to whether the causal factor involved was materialistic or nonmaterialistic. She grouped the 17 categories of Piaget plus "Trickery" into the following materialistic—nonmaterialistic sequence:

1. Materialistic sequence
    3. Phenomenistic causality
    10. Reaction of surrounding medium
    11. Mechanical causality
    14. Schemas of condensation and rarefaction
    15. Atomistic composition
    16. Spatial explanation
    17. Logical deduction
    18. Trickery
2. Nonmaterialistic sequence
    a. External
        1. Motivational
        2. Finalism
        5. Magical causality
        6. Moral causality
        7. Artificialistic causality
    b. Internal
        4. Participation
        5. Animistic causality
        9. Dynamic causality
        12. Causality by generation
        13. Substantial identification

Of the two categories of the nonmaterialistic sequence, the external contains those explanations in which a nonmaterialistic force outside the situation to be explained is appealed to in the explanation; the internal category those in which an appeal is made to a nonmaterialistic force within the phenomenon to be explained. Deutsche subdivided the materialistic sequence since 83 per cent of the explanations of her sample fell into this category. Her definitions of the five subdivisions of the materialistic sequence are:

1. Fairly complete mechanical explanation with induction of the principles involved. Correct cause-and-effect relation, with generalization of principles.

2. Fairly complete mechanical explanation without recognition of principles involved. Cause-and-effect relation presented without explanation of principles explaining this relationship.
3. Mention of principles involved in the phenomena, without tying these up to the actual mechanical explanation.
4. Incomplete mechanical explanation. No recognition of principles involved, nor indication of the causal relationship. Appeal to mechanical causes with no indication of what the cause-and-effect relationship is.
5. Phenomenalism. Two facts given together in perception, but no cause-and-effect relation given, nor any principle to explain the relationship.

The Sample

The total sample consisted of 850 subjects: 565 hearing and 285 defective hearing ranging between 10 and 20 years of age. Hearing subjects were in grades five through twelve in the Minneapolis Public Schools and at Moosheart, Illinois. Defective hearing subjects were in the same grade range in special day classes for the deaf in Minneapolis, St. Paul and Milwaukee, and from the state schools for the deaf in Minnesota and Wisconsin. All subjects were given the Pintner Non-Language Mental Test at the time they wrote their causal explanations. In addition, all had been given a test of hearing acuity with a Maico 4A audiometer within the year previous to the study. A percentage of hearing loss was computed for each subject according to the method advocated by the American Medical Association (1). For the several analyses, samples were selected from the total group of subjects.

Analysis

The written explanations were compared: (1) by age for the experimental sample of hearing and defective hearing subjects and (2) among three experimental groups of hearing, hard of hearing, and deaf subjects matched on age, sex, intelligence and grade placement.

Hearing and defective hearing samples. Although 565 hearing subjects were tested, only the 293 subjects from Mooseheart are included in the experimental hearing

sample since their mean age is more comparable to that of the defective hearing sample. The mean CA of the 285 defective hearing subjects is 15.6 years; the mean CA of the Mooseheart sample is 14.4 years; the mean CA of the total hearing sample is 13.2, reflecting the large proportion of the ten, eleven, and twelve year olds in the Minneapolis sample. In Table 1 the description of the hearing and the defective hearing subjects is presented by age. None of the hearing subjects had a hearing loss greater than ten per cent. The mean hearing loss for the defective hearing is 70.5 per cent, with a range from about 15 to 100 per cent hearing loss. No means have been computed for any age levels in which there were fewer than ten cases.

TABLE 1

NUMBER, MEAN GRADE PLACEMENT AND PINTNER INDEX BY AGE

Age	10	11	12	13	14	15	16	17	18	19	20
Hearing Subjects (N = 293)											
Number	13	19	33	33	42	43	40	46	21	2	1
Mean grade placement	5.5	5.9	6.7	7.6	8.9	9.5	10.7	11.5	12.0	—	—
Mean Pintner Index	71	65	60	59	65	64	64	67	66	—	—
Defective Hearing Subjects (N = 285)											
Number	2	6	17	38	41	32	40	33	30	29	17
Mean grade placement	—	—	5.8	6.3	6.9	7.0	9.1	9.5	9.8	11.4	11.6
Mean Pintner Index	—	—	58	57	60	57	59	62	66	63	47

There is no real difference in the mental ability of the hearing and defective hearing subjects. According to the standardization data, Pintner Indexes between 40 and 59 are evaluated as "normal" and include about 50 per cent of the subjects; indexes between 60 and 79 are evaluated as "bright" and include 22.8 per cent of the subjects (4). Only the mean index of the 20 year old defective hearing subjects falls as low as the upper range of the "normal" interval. Although both hearing and defective hearing show an increase in grade placement with increasing age, the increment is considerably greater for the hearing than for the defective hearing. The retardation in grade placement of the defective hearing is less than one grade

at 12 years, and increases to about two grades at 18 years. This trend is in agreement with most studies, although the actual retardation is somewhat less than the four or five years' frequently reported for educational achievement.

Matched Groups. In order to match hearing, hard of hearing and deaf subjects, each case was classified under one of these categories according to his degree of hearing. All children in regular classes with either a satisfactory sweep-check audiometric test or a calculated percentage of hearing loss of less than ten per cent were classified as "hearing"; those in special classes for the defective hearing with a hearing loss between 10 and 60 per cent were classified as "hard of hearing"; those in special classes with a hearing loss greater than 60 per cent were classified as "deaf."

From the total sample, 78 deaf, 78 hearing and 78 hard of hearing subjects were matched on sex, age within six months, grade placement within one grade, and Pintner Non-Language Mental Test scores within 15 points. Mean scores on these matching variables (except sex) and the significance of the differences between them are presented in Table 2. No difference except that between the grade placement of the deaf and the hearing which reaches the five per cent level of confidence is statistically significant. A CR of 2.63 is necessary to reach the one per cent level of confidence and one of 1.99 to reach the five per cent level.

TABLE 2

SIGNIFICANCE OF THE DIFFERENCES BETWEEN THE MATCHING VARIABLES FOR THE MATCHED GROUPS

	Mean Frequency						
	Hearing (N = 78)	Hard of Hearing (N = 78)	Deaf (N = 78)	Diff.	Sigma Diff.	CR	Level of Significance
CA	14.3	14.6		.3	0.32	.94	
	14.3		14.6	.3	0.32	.94	
		14.6	14.6	.0	0.33	.00	
Grade Placement	8.0	7.7		.3	0.32	.94	
	8.0		7.3	.7	0.32	2.19	.05
		7.7	7.3	.4	0.32	1.25	
Pintner Score	449.7	451.0		1.3	12.17	.09	
	449.7		449.4	.3	11.37	.03	
		451.0	449.4	1.6	12.02	.13	

Results of Analysis of Comparison of Hearing and Defective Hearing Samples

Piaget Classification. The percentage of explanations falling into each of the 17 Piaget categories plus the "Trickery" category of Deutsche are shown in Table 3 for the hearing and defective hearing experimental samples and for the complete sample from the Deutsche study. For all three samples phenomenistic, dynamic, and logical

TABLE 3

PERCENTAGE OF ALL ANSWERS FALLING INTO EACH CATEGORY OF THE PIAGET CLASSIFICATIONS

Type of Causality	Hearing (N = 293) (CA 14.4)	Defective Hearing (N = 285) (CA 15.6)	Deutsche Sample (N = 732) (CA 11.9)
1. Motivational	0.4	0.2	0.3
2. Finalistic	0.3	0.1	0.3
3. Phenomenistic	16.7	31.4	20.8
4. Participative	0.0	0.0	0.0
5. Magical	1.1	2.4	1.1
6. Moral	0.6	0.6	0.9
7. Artificialistic	0.0	0.0	0.0
8. Animistic	0.3	0.3	0.3
9. Dynamic	3.4	3.3	6.3
10. Surrounding Medium	0.0	0.0	0.0
11. Mechanical	37.3	31.9	38.9
12. Generative	0.8	1.0	0.4
13. Substantial identification	0.2	0.0	0.1
14. Condensation, rarefaction	0.0	0.0	0.0
15. Atomistic	0.0	0.0	0.0
16. Spatial	0.0	0.0	0.1
17. Logical	31.2	14.8	23.4
18. Trickery	0.2	0.2	0.2
Unclassifiable	7.5	13.0	6.7

deduction are most frequent. The defective hearing use considerably more phenomenistic explanations (a less mature type of reasoning) and less logical deduction (a more mature type) than the hearing children. More explanations of the defective hearing cannot be classified. This category includes omissions, statements such as "I don't know," and a few unintelligible answers. The difference between the hearing and defective hearing holds when actual omissions are separated out from the unclassifiable explanations. The defective hearing also resort to magical explanations somewhat more frequently.

Since the mean CA of the Deutsche sample is 11.9 years, two and a half years younger than that of the hearing and

defective hearing samples in the present study, direct comparisons among the samples are not justified. When the discrepancy in mean ages between the Deutsche and the Moosheart sample is considered, the differences in the types of explanations offered are about as expected, and indicate substantial similarity between the hearing subjects in the two studies.

As many as three per cent of the explanations given at any age are found in only four categories of explanations: phenomenistic, mechanical, dynamic and logical deduction. Dynamic explanations hover around three per cent of the explanations of both the hearing and the defective hearing throughout the entire age range. The age trends in the other three categories and in the unclassifiable explanations are presented in Figure I.

For both hearing and defective hearing groups phenomenistic explanations decrease with age and explanations by logical deduction increase with age. Age for age the hearing children use more logical deduction than the defective hearing children. At ten years of age 12.8 per cent of the explanations of the hearing are of this type, but not until the defective hearing are 14 or 15 years of age do their explanations reach this percentage. At 18 years of age, 44.4 per cent of the explanations of the hearing and only 20.4 per cent of those of the defective hearing use logical deduction. The significance of the differences among the samples in the use of the various types of reasoning has been computed only for the matched groups since the controls are more rigid.

Defective hearing children use more phenomenistic explanations than hearing children of the same ages. At eighteen years, 29.4 per cent of the explanations of the defective hearing and only 8.6 per cent of the hearing are in this category. Only at ten years do the hearing children have so large a percentage of phenomenistic explanations. Phenomenistic explanations make up nearly 75 per cent of the explanations of the defective hearing at eleven years of age and 50 per cent at 14 years. This latter percentage is higher than that used by the ten year old hearing subjects in the present study or by the eight year olds in the Deutsche study. The percentage of phenomenistic explanations

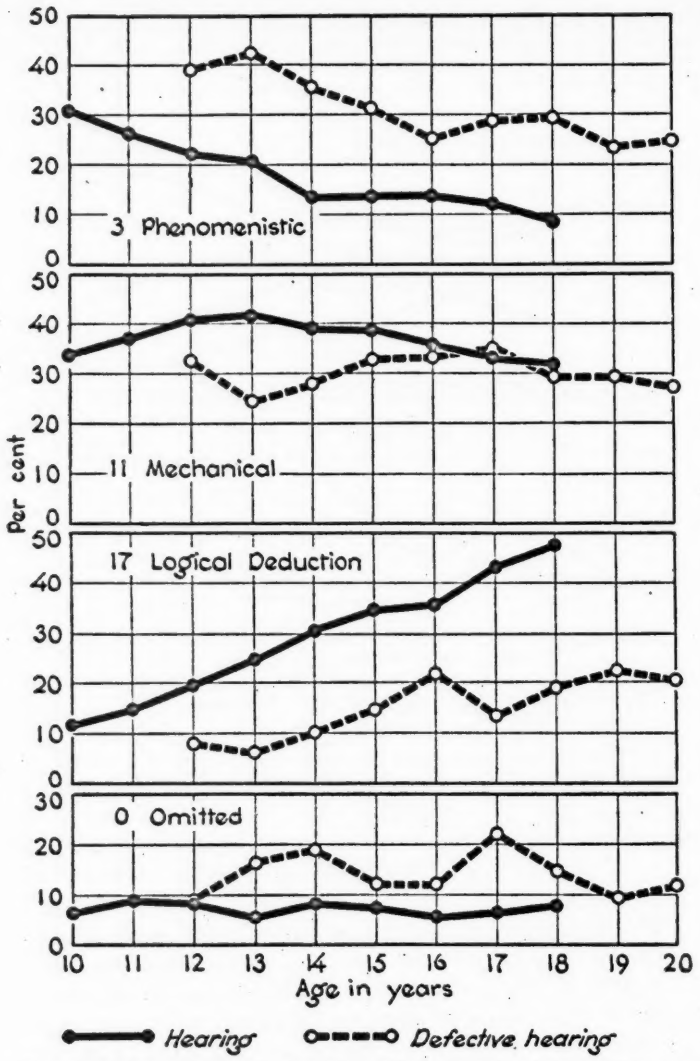

FIGURE I. Percentage of explanations of hearing and defective hearing samples by age, classified as phenomenistic, mechanical or logical deduction or omitted.

offered by the 19 and 20 year old defective hearing subjects is about equal to the percentage offered by 12 year old hearing subjects.

There is a tendency for the use of mechanical explanations to increase with age for the defective hearing, but a slight initial increase is followed by a slight decrease, and then a leveling off for the hearing. After about 16 years there is great similarity in the proportionate use of mechanical explanations by both groups.

The proportion of explanations which fall into the various Piaget categories is essentially similar for the present hearing sample and for Deutsche's sample.

Deutsche classification. When the explanations are classified according to the Deutsche categories, both those of the hearing and of the defective hearing are predominantly materialistic. The number of nonmaterialistic explanations decreases with increasing age, but at no age are less than 73 per cent of the explanations materialistic. Slightly more nonmaterialistic explanations are offered by the defective hearing.

In Figure II the percentage of materialistic explanations are graphed according to the subdivisions of the materialistic sequence used. The hearing subjects use higher levels of generalization than the defective hearing at earlier ages. At twelve years of age, the two highest levels of generalization include about 25 per cent (4.2

TABLE 4

PERCENTAGE OF MATERIALISTIC AND NONMATERIALISTIC EXPLANATIONS OF HEARING AND DEFECTIVE HEARING SUBJECTS BY AGE

	CA										
	10	11	12	13	14	15	16	17	18	19	20
Hearing											
Materialistic	76.5	79.5	83.2	89.2	83.6	86.7	86.0	88.0	87.7		
Nonmaterialistic											
External	7.7	4.6	3.3	3.2	1.9	1.4	3.3	1.4	0.8		
Internal	7.7	4.4	4.2	3.9	5.8	4.0	4.7	4.6	4.0		
Total	15.4	9.0	7.5	7.1	7.7	5.4	8.0	6.0	4.8		
Unclassifiable	8.1	11.5	9.3	5.7	8.7	7.9	6.0	6.0	7.5		
Defective Hearing											
Materialistic			79.6	73.4	73.7	78.6	80.6	77.5	78.7	85.3	75.5
Nonmaterialistic											
External			5.3	6.5	3.2	3.6	3.4	1.8	1.5	2.2	1.5
Internal			6.2	3.7	4.2	5.3	3.8	5.9	5.0	2.8	6.3
Total			11.5	10.2	7.4	8.9	7.2	7.7	6.5	5.0	7.8
Unclassifiable			8.9	16.4	18.9	12.5	12.2	14.8	14.8	9.7	16.7

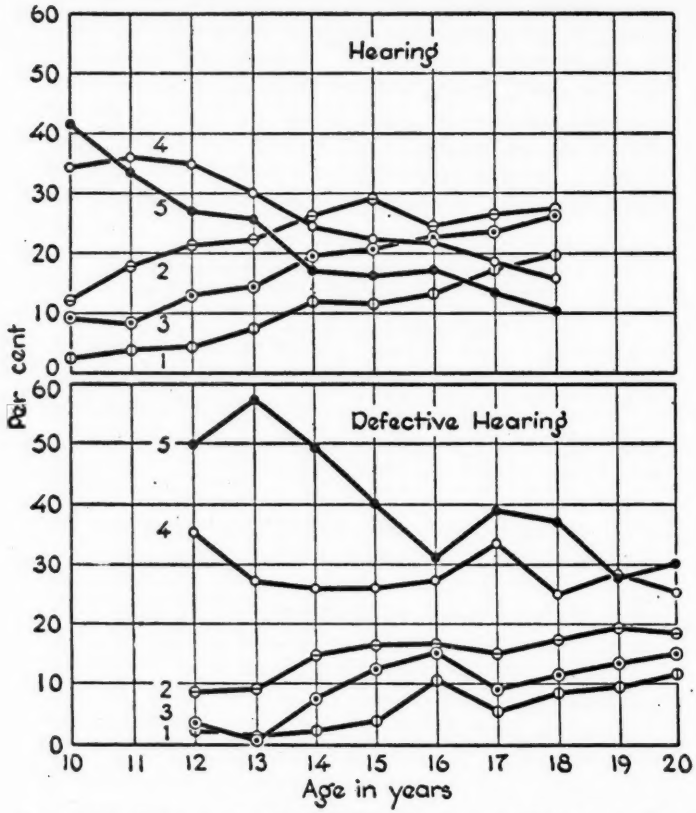

FIGURE II. Per cent of each subdivision of the materialistic sequence used by hearing and defective hearing samples by age.

and 21.1) of the explanations of the hearing and only about eleven per cent (2.1 and 8.8) of the explanations of the defective hearing. At this age slightly over 50 per cent (24.7 and 27.0) of the explanations of the hearing as compared with almost 85 per cent (35.6 and 50.0) of the defective hearing are in the lowest levels of generalization. At eighteen years 19.9 per cent of the explanations of the hearing are at the highest level of generalization. At this same age 8.8 per cent of the explanations of the defective hearing are in this category, and the percentage rises only to 11.7 per cent by twenty years of age.

At eighteen years of age, 10.2 per cent of the explanations of the hearing subjects and 37.6 per cent of those of the defective hearing are at the lowest level of generalization. This percentage decreases to 30.3 for the twenty year old defective hearing. This percentage is exceeded by hearing children only at ten and eleven years of age. Subjects of Deutsche's study were even more advanced in level of generalization used: the highest level of generalization was made in 9.8 per cent and the lowest level in 18.3 per cent of the explanations offered by Deutsche's twelve year olds.

Results of Analysis of Explanations of Matched Groups

Piaget Classification. The significance of the differences among the three matched groups in the percentage of use of phenomenistic, dynamic, mechanical and logical deduction explanations are presented in Table 5. Hearing subjects use logical deduction in their explanations more frequently and they use phenomenistic causal explanations less frequently than the defective hearing. Differences

TABLE 5

SIGNIFICANCE OF DIFFERENCES IN THE USE OF FOUR PIAGET CATEGORIES AMONG THE MATCHED GROUPS

Piaget Category	Per cent of explanations			Critical Ratios		
	Hearing (1) (N = 78)	Hard of Hearing (2) (N = 78)	Deaf (3) (N = 78)	1 vs 2	1 vs 3	2 vs 3
3. Phenomenistic	19.0	24.3	35.8	0.83	2.31	1.58
9. Dynamic	3.3	3.7	3.2	0.14	0.04	0.17
11. Mechanical	37.3	37.9	28.9	0.08	1.12	1.20
17. Logical Deduction	28.0	21.3	10.6	0.97	2.93	1.93

between the hearing and the deaf are significant at the one per cent level of confidence in the use of logical deduction and at the two per cent level in the use of phenomenistic causality. Differences in the frequency of use of dynamic and mechanical explanations are not significant.

The hard of hearing are more similar to the hearing than to the deaf in the kinds of explanations they offer. In no instance does the difference in the frequency of the use of the various types of explanations by the hard of hearing and the hearing approach statistical significance. Between the deaf and the hard of hearing, however, although none of the differences in use is significant at the five per cent level, that of the use of logical deduction approaches the

five per cent level and that of phenomenistic explanations, nears the ten per cent level of confidence.

Deutsche Classification. Materialistic explanations are characteristic of all three matched groups (Table 6). Although the deaf use materialistic explanations least frequently, 75.8 per cent of their explanations are in this category and there are no significant differences among the groups in their use of materialistic and nonmaterial-

TABLE 6

SIGNIFICANCE OF DIFFERENCES IN THE USE OF MATERIALISTIC AND NONMATERIALISTIC EXPLANATIONS AMONG MATCHED GROUPS

CATEGORY	PER CENT OF EXPLANATIONS			CRITICAL RATIOS		
	Hearing (1) (N = 75)	Hard of Hearing (2) (N = 75)	Deaf (3) (N = 75)	1 vs 2	1 vs 3	2 vs 3
Materialistic	84.5	83.6	75.8	0.15	1.37	1.22
Nonmaterialistic						
External	2.3	2.6	3.9	0.12	0.56	0.47
Internal	4.3	5.2	5.4	0.26	0.32	0.06
Total	6.6	7.8	9.3	0.29	0.62	0.34
Unclassifiable	8.9	8.6	14.9	0.07	1.16	1.23

istic explanations. However, the matched groups differ in the frequency of their attempts to explain natural phenomena.

The category "Unclassifiable" in Table 6 includes both irrelevant or unintelligible and omitted responses. Explanations are omitted in 7.6 per cent of the possible responses of the hearing, in 6.8 per cent of those of the hard of hearing, and in 9.3 per cent of those of the deaf. For the hearing, 1.3 per cent of their explanations are irrelevant or unintelligible; for the hard of hearing 1.8 per cent, and for the deaf 5.6 per cent. Although the deaf write unclassifiable explanations more frequently than the hearing or the hard of hearing, the differences are not statistically significant. It should be emphasized that in 85 per cent of the opportunities to explain, the profoundly deaf subjects have written some classifiable explanations.

The significance of the differences in the use of the various levels of generalization by the hearing and the defective hearing is presented in Table 7. The deaf subjects' use of the least generalized materialistic explanations is significantly more frequent than the hearing at the one tenth of one per cent level of confidence; the middle level of generalization at the two per cent level. Although

TABLE 7

SIGNIFICANCE OF DIFFERENCES IN THE EXPLANATIONS IN SUBDIVISIONS OF THE MATERIALISTIC SEQUENCE AMONG MATCHED GROUPS

	PER CENT OF EXPLANATIONS			CRITICAL RATIOS		
Subdivision	Hearing (1) (N = 78)	Hard of Hearing (2) (N = 78)	Deaf (3) (N = 78)	1 vs 2	1 vs 3	2 vs 3
1	10.0	8.7	3.6	0.28	1.60	1.33
2	22.3	17.7	13.1	0.72	1.52	0.80
3	19.5	14.3	6.1	0.87	2.56	1.71
4	25.6	30.2	29.7	0.64	0.57	0.07
5	22.9	29.1	47.6	0.88	3.33	2.41

the differences in frequency of use of the other levels is not statistically significant the lesser use of the two higher levels of generalization by the deaf approaches the ten per cent level of confidence.

The hard of hearing are more similar to the hearing than to the deaf in their use of generalization. In no instance does the difference in use of generalization by the hearing and the hard of hearing approach significance. The differences between the hard of hearing and the deaf are significant at the two per cent level at the lowest level of generalization and at the ten per cent level of confidence at the third level of generalization. Except at the fourth level of generalization, where the scores are nearly identical, the deaf are more immature than the hard of hearing in their use of generalization.

Summary and Discussion

Explanations of the causes of 21 physical phenomena were written by 293 defective hearing and 565 hearing subjects between ten and twelve years of age. These explanations were classified qualitatively according to the methods of Piaget and Deutsche. Comparisons were made between the explanations of 1) the entire sample of defective hearing and 293 of the hearing subjects and 2) three matched groups: 78 deaf, 78 hard of hearing and 78 hearing subjects matched on age, sex, grade placement and intelligence.

Analysis of the explanations according to Piaget indicated:

1. The explanations of all the subjects most frequently fall into phenomenistic, dynamic, mechanical and logical deduction categories.

2. Explanations by logical deduction show an increase and phenomenistic explanations show a decrease with age for both hearing and defective subjects.

3. Explanations by mechanical causality decrease with age for the hearing and increase with age for the defective hearing until about sixteen years when the proportions are quite similar for both groups.

4. The deaf are retarded about five to eight years in the kinds of explanations offered: the difference in the use of phenomenistic and logical deduction explanations in the matched groups is significant at the two per cent level.

5. Although more of the explanations of the deaf are unclassifiable or irrelevant, some 85 per cent of their explanations can be classified.

6. The explanations of the hard of hearing are more similar to those of the hearing than to those of the deaf.

Analysis of the explanations classified according to the Deutsche sequence indicated:

1. Explanations of the hearing and the defective hearing are predominantly materialistic.

2. The per cent of materialistic explanations increases slightly with age for all groups.

3. The deaf are retarded seven to eight years in the levels of generalization used in materialistic explanations.

4. The deaf, when matched with hearing subjects on age, sex, intelligence and grade placement use the least generalized level of explanation significantly more frequently at the .001 level.

5. The hard of hearing resemble the hearing more than the deaf in the level of generalization used in materialistic explanations.

The findings of this study have important implications for the training of the defective hearing. Previously the causal explanations of the defective hearing have been shown to be less accurate than those of the hearing. This was not unexpected since the kind of causality investigated was known to be dependent upon training and experience. In the present study, however, it was found that both in the type of causative sources to which the deaf subjects appeal and in the level of generalization used in their materialistic explanations they are retarded at least as

much as in the accuracy of their explanations. Since this retardation persists even when intelligence is controlled, a heavy share of the burden for this deficiency must be attributed to the specific training of these deaf subjects. That the defective hearing, grade for grade and age for age, have not acquired as much information as their hearing mates has been recognized for many years. That the training procedures for the deaf are probably restricting their approach to problems as well as their acquisition of knowledge presents a real challenge.

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SUMMER SCHOOLS FOR TEACHERS OF THE DEAF AND HARD OF HEARING
1954

College, University or Clinic	Location	Director	Term	Courses Offered	Credits Offered	Tuition Fees	Faculty
CALOFORNIA Los Angeles State College	Los Angeles, 855 N. Vermont Ave.	Albert D. Graves	June 21–July 30	Atypical Child, Deaf-blind, Audiology, Acoustic Trg., Methods of Teaching Deaf, Practice Teaching, Psychology of the Handicapped, Speech Clinic, Speech Correction, Speech-reading, Language for the Deaf, Parent Institute	Graduate—Undergraduate	$8.00 per unit	Dr. Francis Lord
John Tracy Clinic [1]	Los Angeles, 806 W. Adams Blvd.	Mrs. Spencer Tracy	June 21–July 29	Audiology & Acoustic Trg., Language for Deaf, Methods of Teaching Deaf, Parent Inst.,—Practice Teaching, Preschool Education of Deaf, Seminar, Speech for Deaf, Speechreading, Psychology of the Handicapped	Graduate Undergraduate	Course I Teachers in service $84.00, others $120.00 Course II Teachers in service $34.00, others $38.00	Mrs. Alathena Smith, Marguerite Stoner, Alice Dorsey
San Francisco State College*[2]	San Francisco			Workshop for Teachers of Deaf in: Methods of Teaching Speechreading, Audiometric Testing, Hearing Conservation, Clinical Practice in Teaching Speechreading	Graduate—Undergraduate		
College of the Pacific	Stockton 4, California	Marc Jant	June 21–Aug. 27	Audiology and Acoustic Training, Speech Clinic, Speech Correction, Speechreading	Graduate—Undergraduate	$155.00—5 weeks	Loida Farrow Howard L. Runion
Whittier College	Whittier, Calif.	Harold F. Spencer	June 21–Aug. 27	Audiology and Acoustic Training, Exceptional Child, Speech Clinic, Speech Correction, Speechreading	Graduate—Undergraduate	$14.00 per unit	Dr. Lester Harris, Dr. Eugene Mills, Thomas McGowan, Lelie Armstrong

COLORADO University of Denver	Denver, Colo.	Alfred C. Nelson	June 21–Aug. 2	Workshop in Education of the Handicapped, Hearing Aid Design and Fitting, Teaching Speech and Language to the Deaf, The Anatomical and Physiological Bases of Speech, Speech Pathology, Methods in Speech and Hearing, Supervised Clinical Practice in Speech and Hearing	Graduate—Undergraduate	State Residents $11.00 per hour Non-residents $11.00 per quarter hour	Warren J. Clark, Ph.D., Marion Downs, Dr. Ruth M. Clark
DISTRICT OF COLUMBIA The Catholic University of America	Washington, D. C.	Roy J. Deferrari	June 28–Aug. 7 Workshop—June 11–22	Atypical Child, Audiology and Acoustic Training, Exceptional Child, Practice Teaching, Psychology of the Handicapped, Rehabilitation Problems of Deaf, Special Education, Speech Correction, Workshop for Teaching of Exceptional Child, Thesis	Graduate—Undergraduate	$15.00 per Session Hour	Summer Session: Rev. Gilbert Hartke, O.P. Workshop: (Special Education of the Exceptional Child) Rev. William F. Jenks, C.Ss.R.
ILLINOIS Northern Illinois State Teachers College	DeKalb			Clinical Practice in Speech and Hearing, Speech Pathology			
Northwestern Univ.*	Evanston, Ill.	Raymond Carhart	6 week session June 18–July 31 Regular session June 18–Aug. 10	Audiology and Acoustic Training, Practice Teaching, Seminar, Speech Clinic, Speech Correction, Speechreading Thesis, Seminar: Hearing and Deafness, Hearing Aids and Residual Hearing, Principles of Clinical Audiology, Supervised Teaching in Speech Correction and Audiology	Graduate—Undergraduate	$13.50 per quarter hour	Marjorie Burkland, Raymond Carhart, John Gaeth, Janet Jeffers, Helmer Myklebust, Harold Westlake, Charles Elliott
Illinois State Normal College*	Normal, Ill.			Aural Rehabilitation, Speechreading			
University of Illinois	Urbana, Ill.	R. B. Browne	June 18–Aug. 14	Exceptional Child, Psychology of the Handicapped, Speech Clinic Speech Correction, Speechreading Thesis	Graduate—Undergraduate		Severina Nelson, James Kelly, James Gallagher, Samuel A. Kirk Oliver P. Kolstoe

SUMMER SCHOOLS FOR TEACHERS OF THE DEAF AND HARD OF HEARING

1954

College, University or Clinic	Location	Director	Term	Courses Offered	Credits Offered	Tuition Fees	Faculty
Indiana							
Ball State Teachers College	Muncie, Ind.	Alan Huckleberry	June 14–Aug. 20	Audiometric Testing, Speech Clinic, Speech Correction, Hearing Conservation and Pathology, Speechreading, Thesis	Graduate—Undergraduate		Roma Hayworth Thiry, Mary M. Jaeger, Alan Huckleberry, Ph. D.
Indiana University*	Bloomington, Indiana	Robert L. Milisen	June 15–Aug. 27	Audiometric Testing, Audiology & Acoustic Training, Survey of Education of the Exceptional Child, Special Education, Speech Clinic, Speech Correction, Speechreading, Thesis			Vincent H. Knauf Robert L. Milisen
Purdue University	Lafayette, Ind.	George Davis	June 14–Aug. 6	Audiology & Acoustic Training, Speech Clinic, Speech Correction, Speechreading, Thesis	Graduate—Undergraduate	State residents $35.00 Non-residents $85.00	M. D. Steer, T. D. Hanley G. Shaffer, F. Patton
Kansas							
University of Kansas	Kansas City, Kansas	June Miller	June 1–July 31	Speech Correction, Audiology & Acoustic Training, Parent Institute, Speechreading	Graduate—Undergraduate	State residents $4.00 per hour Non-residents: $9.25 per hour	Cornelius Goetzinger
Michigan							
Wayne University	Detroit, Mich.	John W. Tenny	June 28–Aug. 6 Intersession Aug. 3–14	Atypical Child, Exceptional Child, Language for Deaf, Methods of Teaching Deaf, Speech Correction, Speech Clinic, Speechreading, Audiometric Testing	Graduate—Undergraduate	State residents: Graduates $11.75 per hr. Undergrads $9.75 per hr. Non-residents: Graduates $21.75 per hour Undergrads $19.75 per hour	Emilie Martyka Thomas Paulos

Michigan State Normal College*	Ypsilanti, Mich.	F. E. Lord		Atypical Child, Exceptional, Child, Speechreading, Audiology and Acoustic Training, Seminar, Special Education, Speech Clinic, Speech Correction, Thesis	Graduate—Undergraduate		
NEBRASKA							
University of Nebraska Teachers College	Lincoln, Neb.	Frank E. Sorenson	June 7–July 30	Clinical Practice in Speech Therapy, Speech Development and Correction, Speech Pathology, Seminar in Speech Pathology and Audiology	Graduate—Undergraduate	State residents $40.00 Non-residents $80.00	D. A. Worcester, John Wiley Lucille Cypreansen
NEW YORK							
Tecahers College, Columbia University*	New York City, 525 W. 120th St.	Maurice H. Fouracre	July 6–Aug. 13	Atypical Child, Exceptional Child, Audiology and Acoustic Training, Methods of Teaching the Deaf, Preschool Education of the Deaf, Psychology of the Handicapped, Special Education, Speech for the Deaf, The Auditory and Vocal Mechanisms, Language for the Deaf, Methods of Teaching Lipreading to the Hard of Hearing, The Measurement of Hearing	Graduate—		Clarence O'Connor, Mrs. Eleanor C. Ronnei, Estelle E. Samuelson, Mary C. New, Paul Rotter, Eleanor Voree,
Syracuse University	Syracuse. N. Y.			Introduction to Hearing and Speech Disorders, Education and Development of Children with Impaired Hearing, Articulation and Voice Disorders, Hearing Aids and Auditory Training, Teaching of Speech to the Deaf and Hard of Hearing			Louis M. DiCarlo, D.Ed.
NORTH CAROLINA							
East Carolina Teachers College*	Greenville, N. C.	Leo W. Jenkins	June 7–Aug. 20	Special Education, Speech Clinic	Graduate—Undergraduate	State resident $20.50 term Non-residents $40.50 term	Rodney W. Everhart Catherine Furbee
Western Carolina Teachers College	Cullowhee, N. C.			The Hard of Hearing Child, The Speech Handicapped Child, Audiometric Testing and Hearing Conservation			

SUMMER SCHOOLS FOR TEACHERS OF THE DEAF AND HARD OF HEARING

1954

College, University or Clinic	Location	Director	Term	Courses Offered	Credits Offered	Tuition Fees	Faculty
Ohio							
Ohio State University	Columbus, Ohio	W. Hayes Yeager	June 21–Aug. 27	Preschool Education of the Deaf	Graduate—Undergraduate		
Kent State University	Kent, Ohio			Exceptional Child, Language for Deaf, Methods of Teaching Deaf, Reading for the Deaf, Speech for the Deaf, Speechreading			
Oklahoma							
University of Oklahoma	Norman, Oklahoma	John W. Keys	June 10–Aug. 8	Exceptional Child, Audiology and Acoustic Training, Language for the Deaf, Practice Teaching, Psychology of the Handicapped, Speech Clinic, Speech Correction, Speechreading	Graduate—Undergraduate	State residents $40.00 Non-residents $100.00	Alice Burtnett, John W. Keys, Ph.D., Percy Teska, Ph.D., John Boland, Ph.D., Laurel Schendel, Verdry Vaughan
Oregon							
University of Oregon	Eugene, Oregon	Paul Jacobson	June 21–Aug. 13	Exceptional Child, Rehabilitation Problems of the Deaf, Speech Clinic, Speech Correction, Speechreading, Thesis	Graduate—Undergraduate		K. S. Wood, Robert West
Pennsylvania							
University of Pittsburgh*	Pittsburgh, Pa.	Jack Matthews	(3 terms) June 14–Aug. 20	Thesis, Speech Clinic, Measurement of Hearing, Psychology of Exceptional Children, Speech Correction, Clinical Practice in Audiology and Acoustic Training, Preschool Education of the Deaf, Speech Correction	Graduate—Undergraduate	$14.00 per Semester credit	Aubrey Epstein, Ph.D. Charlotte Avery

The Pennsylvania State University	State College, Pennsylvania	M. R. Trabue	June 8–Aug. 27	Atypical Child, Audiology and Acoustic Training, Exceptional Child, Practice Teaching, Psychology of the Handicapped, Rehabilitation Problems of the Deaf, Special Education, Speech Clinic, Speech Correction, Parent Institute	Graduate—Undergraduate	$11.00 per credit	Bruce M. Siegenthaler, E. T. McDonald, A. J. Berlin, James Frick
TENNESSEE							
University of Tennessee	Knoxville, Tenn.	N E. Fitzgerald	June 14–Aug. 21	Atypical Child, Audiology and Acoustic Training, Speech Correction, Speech Clinic, Audiometric Testing, Psychology of Exceptional Children, Speechreading	Graduate—Undergraduate	State residents $25.00 (6 wks) Non-resident $37.50 (6 weeks)	Marline Parish
George Peabody College	Nashville			Audiology and Speech Correction, Preschool Deaf Children, Speech Clinic, Testing of Hearing			
TEXAS							
University of Houston			June 7–Aug. 28	Foundations of Hearing, Speech Correction, Clinical Practice in Speech and Hearing Therapy, Speech for the Deaf, Language Development for the Deaf			Jack L. Bangs, Genevieve Arnold, Audrey Hicks
VIRGINIA							
University of Virginia*	Charlottesville	Lindley J. Stiles	June 16–Aug. 14	Exceptional Child, Practice Teaching, Aural Rehabilitation, Special Education, Speech Clinic, Speech Correction, Thesis	Graduate—Undergraduate	State resident $7.50 sem. hr. Non-residents $15.00 sem. hr.	James M. Mullendore Malcolm B. McCoy Carl C. Durkee Raymond C. Heidloff
Virginia State College*	Petersburg, Va. Hampton, Va.		June 14–July 23	Psychology of Exceptional Children, Psychology of the Handicapped, Acoustic Training, Speechreading, Reading for the Deaf, Language of Signs, Speech for the Deaf, Thesis, Workshop for Teachers of the Deaf, Special Education for the Deaf, Special Techniques	Graduate—Undergraduate		Elizabeth Benson, Joseph P. Youngs

SUMMER SCHOOLS FOR TEACHERS OF THE DEAF AND HARD OF HEARING
1954

College, University or Clinic	Location	Director	Term	Courses Offered	Credits Offered	Tuition Fees	Faculty
Wisconsin University of Wisconsin*	Madison, Wis.	John Guy Fowlkes	June 25–Aug. 20	Exceptional Child, Speech Clinic, Hearing Rehabilitation, Speech Correction	Graduate—Undergraduate	State residents and Non-residents $70.00	Prof. Newland Prof. Gwen Arnold Prof. John V. Irwin
Marquette University	Milwaukee, Wis.	Rev. Eugene H. Kessler, S. J.	June 21–July 30	Speech Clinic, Speech Correction, Audiology and Acustic Training, Psychology of the Handicapped, Speechreading, Workshop	Graduate—Undergraduate	$17.50 per credit	Alfred J. Sokolnicki Genevieve E. Raaf
Wisconsin State College	Milwaukee, Wis.	A. A. Suppan	June 21–July 30	Exceptional Child, Parent Inst., Language for the Deaf, Speech for the Deaf, Phonetics	Graduate—Undergraduate		Lois Field, Agnes Jensen

* Deaf students may enroll (University of Colorado will provide interpreters
Virginia State College will provide interpreters)
[1] Affiliation: University of Southern California
[2] Affiliation: Bureau of Special Education—California State Department of Education
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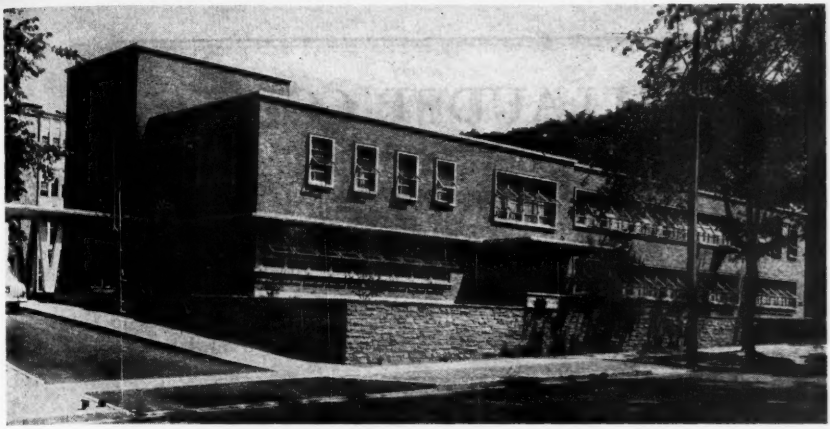

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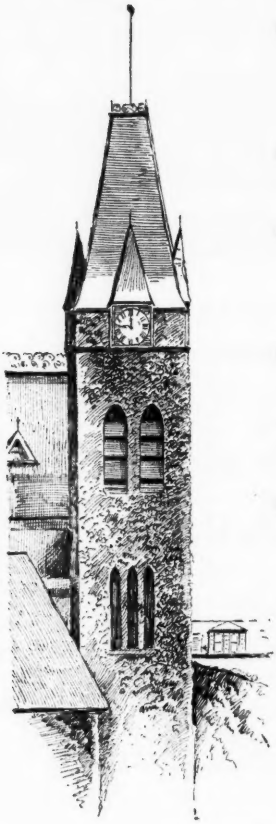

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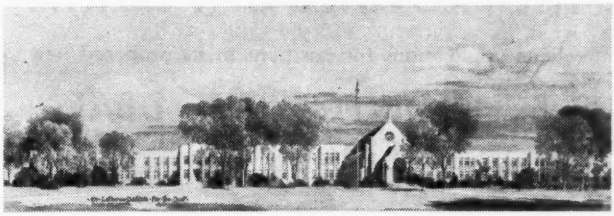

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Auditory training of deaf and hard of hearing children.

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The toxic effect of streptomycin on the vestibular and cochlear apparatus.

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No. 101 *Palva,* Tauno, M.D., Otol. Clinic, Turku, Finland. 1952
Finnish speech audiometry.

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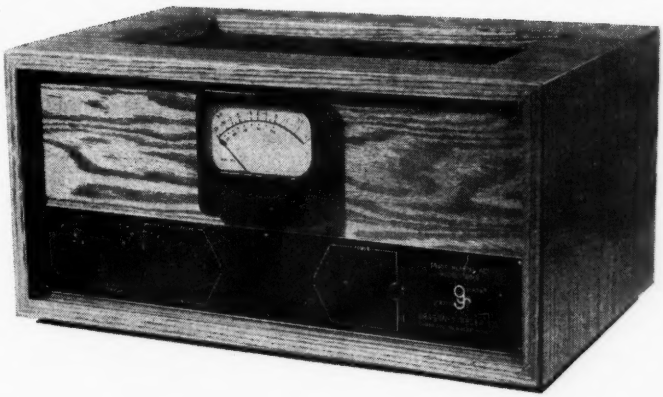

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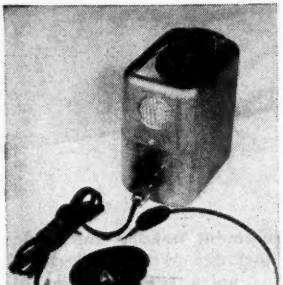

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Hearing SOUND is important—but not most important. Each sound is an individual pattern. AUDITORY TRAINING EQUIPMENT must reproduce these sound patterns accurately so that the user may build a foundation of words that will produce a useful language. To attain this goal make GATED COMPRESSION your choice . . . and that's WARREN of course!

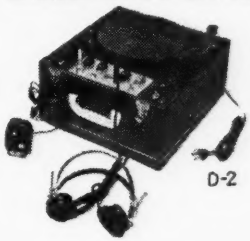
D-1

Warren Custom Built Desk Model D-1

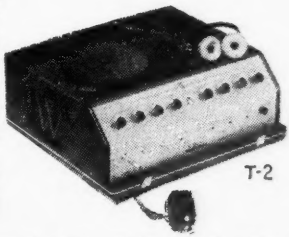
Output jack provided so that THREE individuals can be accommodated at one time. Special terminal on front panel with calibrated control so TV, RADIO or PHONO can be used with the unit. Designed for individuals with severe hearing losses. Excellent for executive board meetings and shut-in's to help them enjoy radio and television, also pre-school children. You will find the D-1 flexible.

Warren Custom Built Portable Model D-2

Output jack provided so that THREE individuals can be accommodated at one time. Special terminal on front panel with calibrated control so TV or RADIO can be used. Unit is housed in portable carrying case containing THREE SPEED TURNTABLE, the latest type ceramic crystal cartridge with precious metal tipped needle—plays all records. Recommended for home or classroom use.



D-2



T-2

ACCEPTED COUNCIL ON PHYSICAL MEDICINE and REHABILITATION AMERICAN MEDICAL ASSOCIATION

Warren Custom Built Professional Model T-2

For use with FOUR to TWENTY students.. Full mixing with THREE microphone circuits and built-in THREE SPEED PHONOGRAPH Ceramic crystal pick-up with precious metal tipped needle—plays all records. Input terminal on front panel with calibrated control so Recorder, TV, Motion Picture Sound, or noise generator can be used.

Our close association with educators of the hard of hearing has enabled us to develop a complete series of Auditory Training Units with finest tone qualities at high amplitude over a wide range. Gated Compression Amplification is an exclusive WARREN development in which the elements of speech are amplified to a predetermined amplitude, maintaining configuration of speech at high intensity levels. This "balanced hearing" feature, heretofore unattainable, yet long desired, enables building of rhythmical sound and speech patterns and places WARREN units in 1st place among educators.

Jay L. Warren, inc.

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ONE OF THE MOST important clues to the character of this man is his hearing aid.

He never allows his hearing impairment to impose a burden on his friends and associates...nor on himself. His Zenith royal-t® is an unmistakable badge of courtesy and consideration, and he wears it proudly. When his physician recommended the use of a hearing aid, he acted upon that important advice without hesitation.

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SEEING plus HEARING!

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1. Captures the child's interest—His eyes quickly focus on moving tapes with bold, black picture–phrase combinations.

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3. Corrects mistakes—When the child makes an error in breath, voiced or nasal sounds, the teacher flicks a switch lighting a color correction window.

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Addition of extension boxes provides audio system for up to 15 pupils. Write for information, prices and details on FREE TRIAL OFFER.

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Caledonia Electronics & Transformer Corp.
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Amplifier Model P-1

Recognized as outstanding for quality of sound so necessary to find and develop residual hearing.

Can be attached to radio or TV with instructions we supply so that sound at its clearest is amplified for child or adult, at home or in school.

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The American Annals of the Deaf

The AMERICAN ANNALS OF THE DEAF was founded in 1847 at the American School for the Deaf in Hartford, Connecticut, by the members of the faculty of that school, which is the first free public school for the deaf in America. Although the journal received the approval of the administrative school authorities, the periodical was first entirely sponsored by the members of the faculty. After two years the ANNALS was discontinued for some months but was revived by the members of the Convention of American Instructors of the Deaf in their first meeting in New York, N. Y., in 1850.

In April, 1861, the publication ceased because of the War Between the States, inasmuch as the membership of the Convention was made up of northerners and southerners in almost equal proportion. In September, 1868, the AMERICAN ANNALS OF THE DEAF resumed publication with the editorial offices on Kendall Green, in Washington, D. C., where it has since remained.

The AMERICAN ANNALS OF THE DEAF is the official organ of the Conference of Executives of American Schools for the Deaf, which was organized in 1868, and of the Convention of American Instructors of the Deaf, founded in 1850. According to the Library of Congress it is the oldest educational publication in the United States still in existence. It is also the oldest journal on the education of the deaf in the world.

The ANNALS is published five times a year, being issued in September, November, January, March, and May. The subscription price is $4.00 a year, payable in advance. If five or more copies of the ANNALS are sent to one address, the subscription price is $3.50 a year. Single numbers sell for seventy-five cents, except for the January number which sells for $2.00. Back issues are available for 1847, 1848, 1849, 1857, and from September, 1868, to the present. Indexes for 1847–1875, 1876–1885, 1886–1895, 1896–1905, are available at $2.00 each. Indexes for 1906–1915, 1916–1925, 1926–1935, 1935–1945, were issued as regular numbers of the ANNALS. All back issues prior to 1930 sell for $1.00 each. All requests for subscriptions or for back numbers should be addressed to Editor, AMERICAN ANNALS OF THE DEAF, Gallaudet College, Washington 2, D. C.

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FOUNDED 1868

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FOUNDED 1850

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